PATENT ABSTRACTS OF JAPAN

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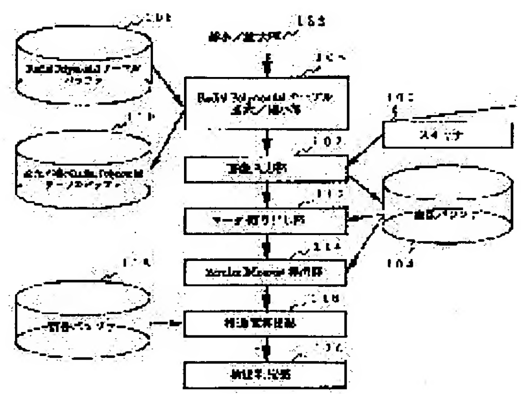
(54) METHOD AND DEVICE FOR SPECIFIC MARK DETECTION

(57)Abstract:

PROBLEM TO BE SOLVED: To cope with the movement, rotation, and power variation of a specific mark without increasing the capacity of a memory needed to detect the specific mark by making use of Zernike moment.



SOLUTION: A radial polynomial table (106) corresponding to the size of the specific mark when the enlargement rate of an input image is maximum is prepared. This table contains only values in a 1/4 area of (x≥0 and y≥0). This table is enlarged or reduced according to the enlargement/reduction rate of the input image and values in the remaining 3/4 area are determined on the basis of the values of the table to complete a table (108). The value of the Zernike moment is calculated (114) by performing product-sum operation between the table and a specific mark candidate image cut out of the input image and the degree of difference from a dictionary (118) is calculated (116), and when the degree of difference is smaller than a threshold value, it is judged (120) that the specific mark has been detected.

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CLAIMS

[Claim(s)]
[Claim 1] The specific mark-detection approach characterized by to ask for the Zernike moment of this image in the approach of detecting the specific mark in an image using the Zernike moment, by sum-of-products count with the table and this image which prepares beforehand the table of a radial polynomial according to the magnitude of a specific mark, generated this table according to contraction/dilation ratio of an image at the time of detection processing, and this generated expansion / table which reduced.

[Claim 2] In the approach of detecting the specific mark in an image using the Zernike moment The table of a radial polynomial according to the magnitude of a specific mark in case the dilation ratio of an image is max is prepared beforehand. The specific mark detection approach characterized by asking for the Zernike moment of this image by sum-of-products count with the table and this image which generated expansion / reduced table and this generated this table according to contraction/dilation ratio of an image at the time of detection processing.
[Claim 3] It is the specific mark detection approach characterized by for the table of the radial polynomial prepared beforehand holding only the value of 1/4 field of (x>=0, y>=0) in the specific mark detection approach according to claim 1 or 2, and determining the value of the remaining fields based on the value currently this held at the time of detection processing.
[Claim 4] The 1st table preservation means which saves the table of a radial polynomial according to the magnitude of a specific mark, An image input means to input with the contraction/dilation ratio which had the image specified, and an image preservation means to save the input image by this image input means, Expansion/contraction means which expands / reduces the table saved for this 1st table preservation means according to contraction/dilation ratio of this input image, The 2nd table preservation means which saves the table expanded / reduced by this expansion/contraction means, A mark logging means to extract the black connected component of the magnitude almost more nearly same than the input image saved for this image preservation means as a specific mark as a specific mark candidate field, A Zernike moment calculation means to compute the magnitude of the Zernike moment by doubling the center of gravity of the image of this specific mark candidate field, and the core of the table saved for this 2nd table preservation means, and carrying out sum-of-products count with this image and this table, A dictionary preservation means to save as a dictionary the average and standard deviation of magnitude of the Zernike moment which were beforehand computed about the specific mark, The dissimilarity calculation section which computes the dissimilarity of the dictionary saved for this dictionary preservation means, and the magnitude of the Zernike moment computed by this TSUERUNIKE moment calculation means, Specific mark detection equipment characterized by having a detection judging means to judge detection / un-detecting based on the dissimilarity computed by this dissimilarity calculation section. [of a specific mark]
[Claim 5] Specific mark detection equipment characterized by saving the table of a radial polynomial according to the magnitude of a specific mark in case the dilation ratio of an input image is max for the 1st table preservation means in specific mark detection equipment according to claim 4.

[Claim 6] It is specific mark detection equipment characterized by for the table saved for this 1st table preservation means holding only the value of 1/4 field of (x>=0, y>=0) in specific mark detection equipment according to claim 4 or 5, and determining the value of the remaining fields by this expansion/contraction means based on the value currently this held.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram of the specific mark detection equipment by one example of this invention.
[Drawing 2] (a) It is drawing showing the example of contraction of a radial polynomial table.
(b) It is drawing showing the example of contraction of a radial polynomial table.
(c) It is drawing showing the example of expansion of a radial polynomial table.
[Drawing 3] (a) It is drawing showing the decision approach of the value of 1/4 field of (x<=0, y>=0) of a radial polynomial table.
(b) It is drawing showing the decision approach of the value of 1/4 field of (x>=0, y<=0) of a radial polynomial table, and 1/4 field of (x<=0, y<=0).
(c) It is drawing showing typically signs that multiply a radial polynomial table and an input image and the Zernike moment is obtained.
[Drawing 4] It is the outline flowchart of processing of radial polynomial table expansion / contraction section.
[Description of Notations]
100 Scanner
102 Image Input Section
104 Image Buffer
106 Buffer for Radial Polynomial Table Storing
110 Buffer for Expansion/Contraction Radial Polynomial Table Storing
112 Mark Logging Section
114 Zernike Moment Calculation Section
116 Dissimilarity Calculation Section
118 Dictionary Buffer
120 Detection Judging Section

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to an image recognition technique, and relates to the approach and equipment which detect the specific mark which may exist in the location of the arbitration in an image especially.
[0002]
[Description of the Prior Art] In an image reader machine, since the location of a manuscript, the sense, and a reading scale factor are not necessarily fixed when it is going to detect the specific mark in the image read in the manuscript, to fulfill the following conditions is desired.
1) It is not influenced of the location (migration) of a specific mark.
2) It is not influenced by the specific mark of rotational.
3) It is not influenced of the variable power (the piece variable power of only one certain direction is also included) of a specific mark.
[0003] As a conventional technique available for such the purpose, there is technique using the Zernike (Zernike) moment which is stated to reference [1] (Whoi-Yul Kimand Po Yuan, "A Practicla Pattern Recognition System forTranslation, Scale amd Rotation Invariance, "Proc.CVPR'94, pp.391-396, and June 1994). Improvement in the speed of processing by table-izing of RadialPolynominal (radial polynomial) is also stated to this reference [1].
[0004] Moreover, eight segments which come out of an alphabetic character image from a center of gravity divide into eight fields, the product of the value of the pixel of the interior and the distance from a center of gravity is computed as the moment for every division field, and the technique of using the cumulative value of the moment for every field as a description for character recognition is stated to JP,6-195512,A. When this technique tends to correspond to rotation of an image and variable power, very complicated control is needed.
[0005]
[Problem(s) to be Solved by the Invention] The technique using the Zernike moment which is stated to said reference [1] can respond to the location of an image, rotation, and variable power, and improvement in the speed of processing by table-izing of the radial polynomial of the Zernike moment is also possible for it. However, in order to realize the practical specific mark detection equipment which can respond to various expansion/reduction percentage of an image by this technique, the device of reducing memory required for preservation of a radial polynomial table is required.
[0006] The purpose of this invention is to offer the practical approach and the equipment for detecting the specific mark in an image using the Zernike moment.
[0007]
[Means for Solving the Problem] In the approach invention according to claim 1 detects the specific mark in an image using the Zernike moment The table which prepares beforehand the table of a radial polynomial according to the magnitude of a specific mark, generated this table according to contraction/dilation ratio of an image at the time of detection processing, and this generated expansion /

reduced table, By calculating sum of products with this image, it is characterized by asking for the Zernike moment of this image.
[0008] In the approach invention according to claim 2 detects the specific mark in an image using the Zernike moment The table of a radial polynomial according to the magnitude of a specific mark in case the dilation ratio of an image is max is prepared beforehand. It is characterized by asking for the Zernike moment of this image by calculating the sum of products of the table and this image which generated expansion / reduced table and this generated this table according to contraction/dilation ratio of an image at the time of detection processing.
[0009] The table of a radial polynomial on which invention according to claim 3 is beforehand prepared by invention according to claim 1 or 2 in the specific mark detection approach holds only the value of 1/4 field of (x>=0, y>=0), and the value of the remaining fields is characterized by determining based on the value currently this held at the time of detection processing.
[0010] 1st table preservation means by which invention according to claim 4 saves the table of a radial polynomial according to the magnitude of a specific mark, An image input means to input with the contraction/dilation ratio which had the image specified, and an image preservation means to save the input image by this image input means, Expansion/contraction means which expands / reduces the table saved for this 1st table preservation means according to contraction/dilation ratio of this input image, The 2nd table preservation means which saves the table expanded / reduced by this expansion/contraction means, A mark logging means to extract the black connected component of the magnitude almost more nearly same than the input image saved for this image preservation means as a specific mark as a specific mark candidate field, A Zernike moment calculation means to compute the magnitude of the Zernike moment by doubling the center of gravity of the image of this specific mark candidate field, and the core of the table saved for this 2nd table preservation means, and carrying out sum-of-products count with this image and this table, A dictionary preservation means to save as a dictionary the average and standard deviation of magnitude of the Zernike moment which were beforehand computed about the specific mark, The dissimilarity calculation section which computes the dissimilarity of the dictionary saved for this dictionary preservation means, and the magnitude of the Zernike moment computed by this TSUERUNIKE moment calculation means, It is characterized by having a detection judging means to judge detection / un-detecting based on the dissimilarity computed by this dissimilarity calculation section. [of a specific mark]
[0011] Invention according to claim 5 is characterized by saving the table of a radial polynomial according to the magnitude of a specific mark in case the dilation ratio of an input image is max for the 1st table preservation means in the specific mark detection equipment by invention according to claim 4.

[0012] The table on which invention according to claim 6 is saved for this 1st table preservation means in the specific mark detection equipment by invention according to claim 4 or 5 holds only the value of 1/4 field of (x>=0, y>=0), and the value of the remaining fields is characterized by what is determined by this expansion/contraction means based on the value currently this held.
[0013]
[Embodiment of the Invention] Hereafter, in order to clarify the gestalt of operation of this invention, one example of this invention is explained using a drawing.
[0014] Drawing 1 is the block diagram of the specific mark detection equipment by one example of this invention. In addition, this specific mark detection equipment is used as independent equipment, or is built into other equipment, for example, digital KOPIA.
[0015] In drawing 1 , the image input section which inputs the scanner for 100 scanning the document set as the object of specific mark detection, and reading image information and the image data of the manuscript with which 102 is set as the object of mark detection using a scanner 100, and 104 are the image buffers for storing the image data inputted from the image input section 102. A buffer for 106 to store the radial polynomial table according to the magnitude of a specific mark to detect, radial polynomial table expansion / contraction section in which 108 generates expansion / reduced table according to the contraction / dilation ratio 122 in the case of an image input of the radial polynomial

table in a buffer 106, and 110 are the buffers for storing the radial polynomial table after expansion/contraction. The mark logging section which starts a mark candidate field according to the magnitude of the specific mark which wants to detect 112 from the input image stored in the image buffer 104, and 114 are the Zernike moment calculation sections which compute magnitude for the Zernike moment of the mark candidate field started by the mark logging section 112 using the radial polynomial table after expansion/contraction saved at the buffer 110. The dictionary memory which stores the dictionary of the specific mark which wants to detect 118, the dissimilarity calculation section which 116 compares with the dictionary of the specific mark in the dictionary buffer 118 the magnitude of the Zernike moment computed by the Zernike moment calculation section 114, and computes dissimilarity, and 120 are the detection judging section which judges detection / un-detecting based on the computed dissimilarity. [of a specific mark]

[0016] Here, it is explained as the Zernike moment about the application to the mark detection. The Zernike moment is defined by the following formula as stated to said data [1] etc. in detail.

[0017]

[Equation 1]

$$R_{nm}(\rho) = \sum_{s=0}^{n-|m|/2} (-1)^s \frac{(n-s)!}{s!\left(\frac{n+|m|}{2}-s\right)!\left(\frac{n-|m|}{2}-s\right)!}\rho^{n-2s} \qquad (1)$$

[0018]

[Equation 2]

$$Re_{(Anm)} = \frac{n+1}{\pi}\int_{x^2+y^2\leq 1} f_{(x,y)} R_{nm}(\rho) cosm\theta dxdy \qquad (2)$$

[0019]

[Equation 3]

$$Im_{(Anm)} = -\frac{n+1}{\pi}\int_{x^2+y^2\leq 1} f_{(x,y)} R_{nm}(\rho) sinm\theta dxdy \qquad (3)$$

[0020] In the above-mentioned formula (1) thru/or a formula (3), n is the degree of the Zernike moment and m is rank. The absolute value of m must be below n, and the number of the differences with the absolute value of n and m must be even.

[0021] Rnm (rho) of the above-mentioned formula (1) is a value which is called a radial polynomial and computed from the distance from rank, a degree, and a core. Re (Anm) of the above-mentioned formula (2) type is the real part of the Zernike moment, and Im (Anm) of the above (formula 3) is the imaginary part of the Zernike moment. Since magnitude Re(Anm)2+Im (Anm)2 of the Zernike moment is a value eternal to rotation of an image, it is applicable to detection of a specific mark. In case it uses, it is necessary to normalize the value of x and y according to the magnitude of a specific mark. That is, system of coordinates are expanded/reduced and are used so that the distance to the furthest point from a center of gravity may be set to 1 centering on the center of gravity of a specific mark.

[0022] In order to actually compute the Zernike moment, whenever a mark candidate field is started, since many processing times are needed, by having performed the operation of the above-mentioned formula (2) and a formula (3), it is not practical. Then, the table (radial polynomial table) of the value calculated by the following formula (4) and the formula (5) according to the magnitude of a specific mark is created beforehand.

[0023]

[Equation 4]

$$ReT_{(Anm)}(x,y) = \frac{n+1}{\pi} R_{nm}(\rho) cosm\theta \qquad (4)$$

[0024]
[Equation 5]

$$ImT_{(Anm)}(x,y) = -\frac{n+1}{\pi} R_{nm}(\rho) sinm\theta \qquad (5)$$

[0025] If this radial polynomial table is used, the Zernike moment is computable by taking the sum of products of each pixel value and the value of a radial polynomial table. That is, it will replace with the above-mentioned formula (2) and a formula (3), and the Zernike moment will be computed by the following formula (6) and the formula (7).
[0026]
[Equation 6]

$$Re_{(Anm)} = \int_{x^2+y^2\leq 1} f_{(x,y)} ReT_{(Anm)}(x,y) dxdy \qquad (6)$$

[0027]
[Equation 7]

$$Im_{(Anm)} = \int_{x^2+y^2\leq 1} f_{(x,y)} ImT_{(Anm)}(x,y) dxdy \qquad (7)$$

[0028] When a radial polynomial table is used and piece variable power of the input image is carried out, the prepared radial polynomial table is expanded/reduced according to the scale factor of piece variable power, and the Zernike moment of a piece variable power image can be computed by applying the radial polynomial table expanded / reduced to an input image.
[0029] Now, at this example, it is created in the form corresponding to [table / which is stored in the buffer 106 / radial polynomial / dilation ratio / of an input image / contraction/dilation ratio / direction / of X] the case (in the case of the piece variable power expanded twice only in the direction of Y) of 2 in 1 and the direction of Y. According to contraction/dilation ratio in case this radial polynomial table is actually inputted into an image, a radial polynomial table required for detection of the specific mark on an input image is generated and used expansion / by reducing.
[0030] Usually, since the maximum/minimum value of the dilation ratio/reduction percentage of an image have become settled with the image input device of scanner 100 grade, when a dilation ratio is max, about the range below the greatest dilation ratio, improvement in detection precision when an image is expanded and inputted can be expected by preparing a radial polynomial table beforehand and saving it (since the resolution of a radial polynomial table is improving). In this example, the profits of such resolution enhancement are obtained to a twice as many expansion as this about the direction of Y.
[0031] Moreover, since a radial polynomial table is a periodic function about rho, it is not necessary to necessarily prepare the value of a radial polynomial table about (x, y) of all fields, i.e., all, only the value about some [required] fields is prepared, and it is possible to also generate the value of the remaining fields easily based on the value. Then, in this example, the radial polynomial table stored in the buffer 106 is a table holding the value of only 1/4 field of (x>=0, y>=0).
[0032] For example, in the case of 48x48-pixel magnitude, the image of a specific mark to detect should just prepare the 24x24-pixel radial polynomial table of (x>=0, y>=0). However, as stated previously, a radial polynomial table is saved in the form where only the direction of Y was expanded twice in this example. Therefore, x directions will call [24 pixels and the direction of Y] 48 pixels the magnitude of the radial polynomial table stored in a buffer 106.
[0033] Hereafter, the concrete contents of processing in this example are explained. In advance of the input of an image, contraction / dilation ratio 122 is inputted by the user using a ten key. Next, in the

image input section 102, an image is read with the specified contraction/dilation ratio using a scanner 100, and the image data is stored in the image buffer 104. Contraction/dilation ratio of x directions and the direction of Y are specified as 1, and an image presupposes that it was inputted without carrying out expansion and contraction here [both].

[0034] Assignment of contraction/dilation ratio of an input image performs processing of radial polynomial table expansion / contraction section 108. The outline of the processing is shown in drawing 4 . In radial polynomial table expansion / contraction section 108, from a buffer 106, a radial polynomial table is read and expansion/contraction of it are done according to contraction/dilation ratio of an image input (step 400). As mentioned above, in this example, the radial polynomial table saved at the buffer 106 is a table corresponding to the case of twice as many direction [as this / of Y] piece variable power, and in order for contraction/dilation ratio to double with the input image of 1, it needs to reduce this table to one half per direction of Y.

[0035] Drawing 2 shows typically the example of expansion/contraction of such a radial polynomial table. (b) of drawing 2 corresponds, when contraction/dilation ratio of an input image are 1, and the radial polynomial table 204 reduced to one half in the direction of Y is obtained by thinning out at a time 1 pixel of values of the radial polynomial table 200 currently prepared beforehand in the direction of Y. In addition, (a) of drawing 2 is an example when an input image is reduced by 2/3 time in the direction of Y, and a table 202 is obtained by thinning out the value of a table 200 at the 2 pixels [per 3 pixels] rate in the direction of Y. (c) of drawing 2 is an example when an input image is expanded by 8/3 time in the direction of Y, and 206 is the table expanded in the direction of Y. The value of the pixel of this table 206 is calculated using the value of 2 pixels or 3 pixels to which the table 200 corresponded about the other pixel, although it is the same as the value of the pixel of the vertical edge of a table 200 about the pixel of a vertical edge.

[0036] Thus, although expansion / reduced radial polynomial table is generated according to contraction/dilation ratio of an input image If it is in this example as mentioned above, the value of the radial polynomial table saved at the buffer 106 is only a value of 1/4 field of (x>=0, y>=0), and only the value of 1/4 field [being the same (x>=0 y>=0)] also has the radial polynomial table expanded / reduced. Then, based on the value of 1/4 field of (x>=0, y>=0) of the radial polynomial after expansion/contraction, radial polynomial table expansion / contraction section 108 determines the value of the 3/4 remaining fields, and completes a table (step 402). How to decide this remaining value is explained with reference to drawing 3 . In addition, the radial polynomial table shown in drawing 3 is the example of the primary the table for real part of the first floor.

[0037] In the case of the table for real part, as shown in (a) of drawing 3 , to 1/4 field of (x<=0, y>=0), the value of 1/4 field of (x>=0, y>=0) is copied for every train, but it copies, after doubling a value -one, when the number of m is odd, and when the number of m is even, a value is copied as it is. Although the same is said of the case of the table for imaginary part, when the number of m is odd, a value is copied as it is, and when the number of m is even, after doubling a value -one, it copies. Next, although the value of 1/4 field [as opposed to 1/4 field of (x<=0, y<=0) (x<=0, y>=0) for the value of 1/4 field to 1/4 field of (x>=0, y<=0) (x>=0, y>=0)] is copied for every line, respectively as shown in (b) of drawing 3 It copies, after doubling a value -one in the case of the table for imaginary part.

[0038] According to such a process, the perfect radial polynomial table for computing the Zernike moment of the image by which the actual size input was carried out is generated in the direction of Y, and this is temporarily saved in it at a buffer 110 from the radial polynomial table which doubled piece variable power and in which only 1/4 field [moreover / (x>=0, y>=0)] has a value (step 4041).

[0039] Next, in the mark logging section 112, the connected component of a black pixel is extracted to the input image stored in the image buffer 104, and the coordinate, for example, the diagonal point coordinate of the circumscription rectangle, is sent to the Zernike moment calculation section 114 by making into a mark candidate field the black pixel connected component judged to have magnitude almost equal to the magnitude of a specific mark to detect. When magnitude of the specific mark which wants to specifically LTh and detect the threshold for decision is set to MSize and the width of face BlW and the height BlH of a black pixel connected component fulfill the conditions of the following two

formulas, the black pixel connected component is detected as a mark candidate field, and the coordinate is sent to the Zernike moment calculation section 114.
[0040]
[Equation 8]

$$(MSize - LTh) < BlW < (MSize + LTh) \qquad (8)$$

[0041]
[Equation 9]

$$(MSize - LTh) < BlH < (MSize + LTh) \qquad (9)$$

[0042] Here, the black pixel connected components A, B, and C as shown in degree table from an input image should be extracted.
[0043]
[Table 1]

	連結成分A	連結成分B	連結成分C
幅	50	51	36
高さ	48	50	29

[0044] Supposing it is MSize=48 and Lth=4, the result of mark logging will become as it is shown in degree table, and only the black pixel connected components A and B will be detected as a mark candidate field.
[0045]
[Table 2]

	連結成分A	連結成分B	連結成分C
幅	50	51	36
高さ	48	50	29
マーク切り出し結果	○	○	×

[0046] In the Zernike moment calculation section 114, from the coordinate passed from the mark logging section 112, a mark candidate field image is captured from the image buffer 104, and the center of gravity of the mark candidate field image is computed. And after doubling the center of gravity and the core of the radial polynomial table saved in the buffer 110, the sum of the product of the pixel value of a mark candidate field image and the correspondence value of this table is calculated. Since a radial polynomial table has two, the object for real part, and the object for imaginary part, sum-of-products count is performed about each. And the sum of the square of the sum of products of real part and the square of the sum of products of imaginary part is calculated, and the magnitude of the Zernike moment is obtained. (c) of drawing 3 shows typically signs that the real part 304 of the Zernike moment is obtained, by multiplying the value of the radial polynomial table (here table for real part) 300, and the correspondence pixel value of an image 302.
[0047] Suppose that a calculation result of the Zernike moment as shown in a degree table was brought as that by which the magnitude of the Zernike moment to the 3rd order is used for mark detection in this example.
[0048]
[Table 3]

	連結成分A	連結成分B
幅	50	51
高さ	48	50
マーク切り出し結果	○	○
1次1階の大きさ	0.00439	0.00298
2次0階の大きさ	0.00036	0.00054
2次2階の大きさ	0.01297	0.00929
3次1階の大きさ	0.00034	0.00084
3次3階の大きさ	0.00500	0.00292

[0049] Average Dic() and standard deviation Std() of magnitude of the Zernike moment for which it asked from two or more images are stored in the dictionary buffer 118 as a dictionary about the specific mark to detect. In the dissimilarity calculation section 116, the dissimilarity Dcb of an input image (mark candidate field image) and a specific mark is computed by the degree type using magnitude F() of the Zernike moment computed by the Zernike moment calculation section 116, and the dictionary of a specific mark.
[0050]
[Equation 10]

$$Dcb = \sum \frac{|Dic(p) - F(p)|}{Std(p)} \qquad (10)$$

[0051] The dissimilarity calculation result of the example and said black pixel connected components A and B of a dictionary of a specific mark is shown in degree table.
[0052]
[Table 4]

	連結成分A	特定マーク平均	特定マーク分散	各次の相違度
1次1階の大きさ	0.00439	0.00375	0.00045	1.42
2次0階の大きさ	0.00036	0.00034	0.00013	0.15
2次2階の大きさ	0.01297	0.01279	0.00154	0.12
3次1階の大きさ	0.00034	0.00032	0.00019	0.11
3次3階の大きさ	0.00500	0.00491	0.00082	0.11
相違度				1.91
	連結成分B	特定マーク平均	特定マーク分散	各次の相違度
1次1階の大きさ	0.00298	0.00375	0.00045	1.71
2次0階の大きさ	0.00054	0.00034	0.00013	1.54
2次2階の大きさ	0.00929	0.01279	0.00154	2.27
3次1階の大きさ	0.00084	0.00032	0.00019	2.74
3次3階の大きさ	0.00292	0.00491	0.00082	2.43
相違度				10.69

[0053] In the detection judging section 120, it judges detection / un-detecting based on the computed dissimilarity Dcb. [of a specific mark] A certain threshold ThD and Dissimilarity Dcb are measured, and, specifically, it judges with the specific mark having been detected at the time of ThD>Dcb. If ThD=4.00, the detection judging result of said black pixel connected components A and B will become as it is shown in degree table.
[0054]
[Table 5]

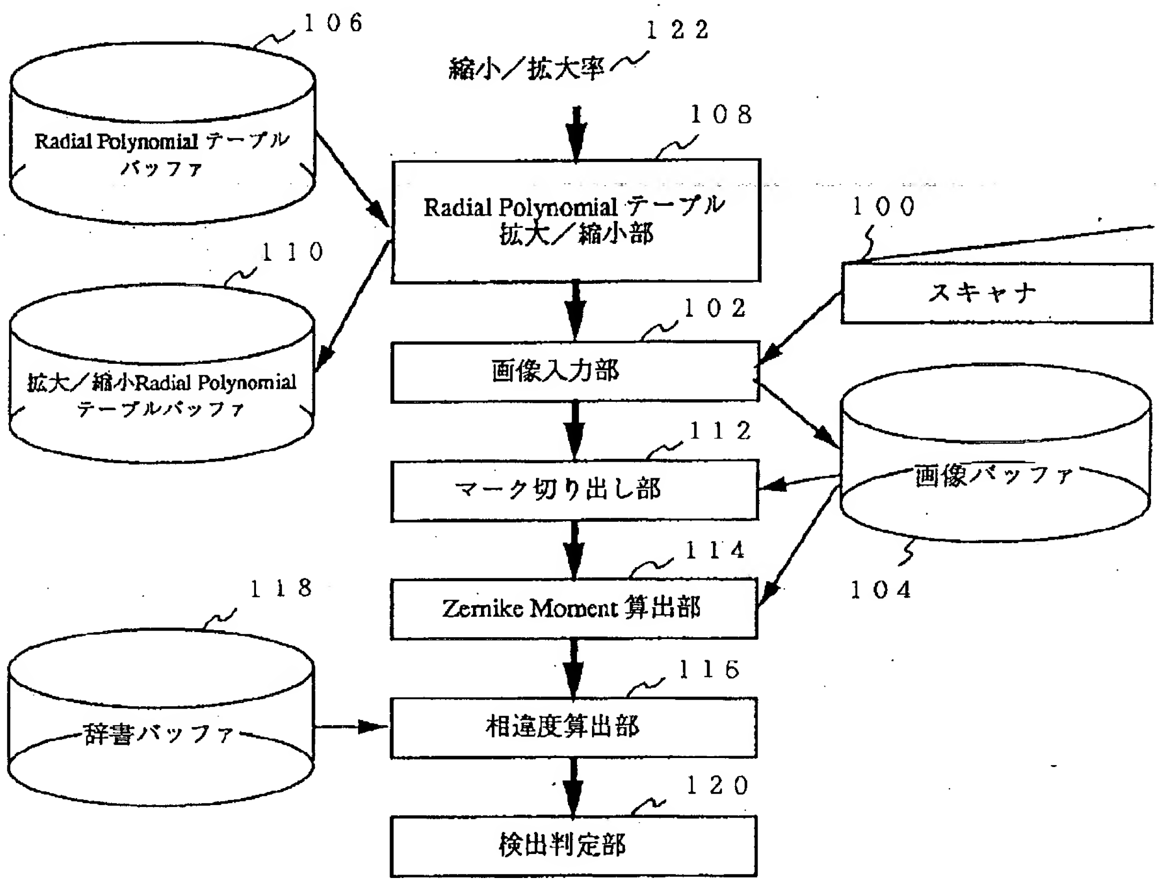
	連結成分A	連結成分B
幅 高さ	50 48	51 50
マーク切り出し結果	○	○
相違度	1.91	10.69
マーク検出結果	○	×

[0055]
[Effect of the Invention] According to invention of 6 claim 1 thru/or given [each] in a term, the specific mark of the rate of variable power of arbitration of the include angle of arbitration in the location of the arbitration in an image is detectable with high precision, and in order high-speed processing is possible, and not to prepare two or more radial polynomial tables corresponding to various expansion/reduction percentage of an image but to prepare only one by using a radial polynomial table, there is little memory space required for preservation of a radial polynomial table, and it ends. According to invention claim 2 and given in five, mark detection precision at the time of [to which the image was expanded] being inputted can be made high by improvement in the resolution of a radial polynomial table. According to invention claim 3 and given in six, since only the value of 1/4 field of a radial polynomial table is saved, memory space (memory space of the 1st table preservation means) required for table preservation is further reducible.

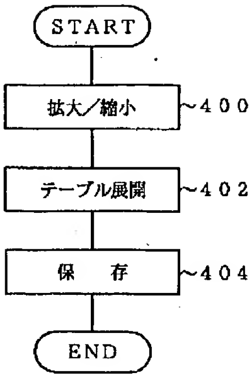
[Translation done.]

DRAWINGS

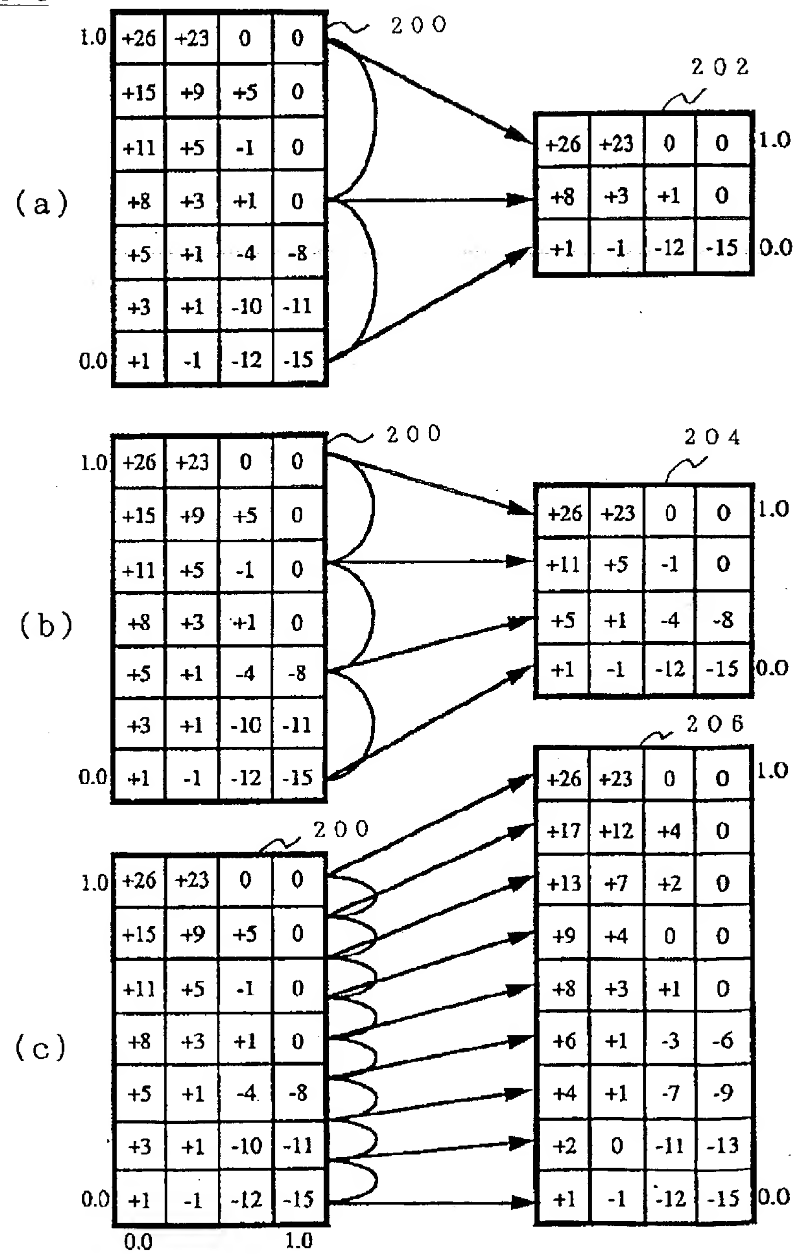
[Drawing 1]



[Drawing 4]

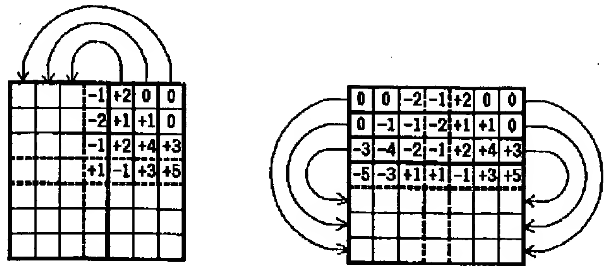


[Drawing 2]

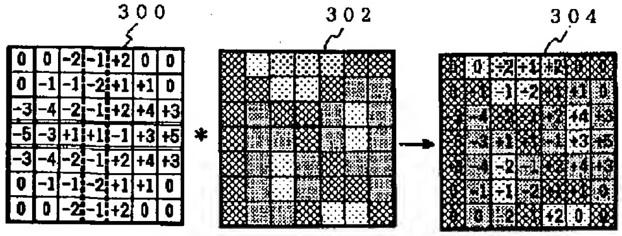


[Drawing 3]

1次1階の実数部用テーブル
(x≧0, y≧0)



(a) (b)



(c)

[Translation done.]